BRITISH JOURNAL OF TUBERCULOSIS AND DISEASES OF THE CHEST

Vol. XLIII. October, 1949 No. 4.

GENERAL ARTICLES

A THERAPEUTIC RATIONALE IN TUBERCULOUS BRONCHO-STENOSIS

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Although recognised pathologically more than one hundred years ago, endobronchial tuberculosis did not receive proper emphasis until the excellent contributions of Eloesser.[1] The growth of thoracic surgery and the willingness of chest physicians to allow routine bronchoscopic examinations of their tuberculous patients have further increased the fund of knowledge in this area. In a careful study of 110 post-mortem examinations, Silverman[2] noted endobronchial and tracheal changes in more than 60 per cent., and found that the more detailed the examination, the more frequent the positive findings. Meissner,[3] studying 60 resected lobes and lungs with routine sections, found 31 with endobronchial changes, of which 15 had previously been described as positive by the bronchoscopist. From a clinical standpoint, the best published series has been that of Salkin, Cadden and Edson,[4] who reported on a five-year study of 622 patients. Routine bronchoscopy on admission showed an incidence of 10 per cent., and further studies during hospital stay raised this figure to 15·5 per cent. of endobronchial changes.

While admittedly endobronchial changes are important clinically, the most significant feature is actual stenosis. Such stenosis depends upon: A—*Type:* (1) Marked inflammatory changes which may clear considerably or go on to true fibro-stenosis; (2) True fibro-stenosis—end result of ulceration and granulations, and may be coexistent with acute or subacute inflammatory change; (3) Where cartilage is involved, the walls of the bronchus may fall together yet not produce true undilatable bronchial stenosis; B—*Amount of stenosis:* If the lumen is reduced to below 50 per cent. permanently, superimposed inflammatory œdema may be sufficient to reduce the lumen further to a critical point; and, finally, C—*The location of the stenotic lesion* is of great clinical importance. If the lesion is in a segment, it is not so important as when in a lobar or stem bronchus.

Pathological changes which occur in the pulmonary parenchyma distal to the stenosis are many and varied. Obstructive emphysema and atelectasis

are both the results of the same obstructive process and depend on the degree of stenosis and the presence or absence of valvular action. Interstitial fibrosis, obliterating bronchitis particularly involving smaller bronchi and bronchioles, and obliteration of the vascular bed, are all results of long standing stenosis. Bronchiectasis with emphysema and blocked or tension cavities are common concomitants. In resected lobes and lungs, the fact that marked atelectasis is present in spite of a small opening still being present in the bronchus presupposes progressive collapse due to intrinsic fibrosis secondary to chronic pneumonitis, in addition to what may be termed " slowing of the air stream."

While it is agreed that stenosis *per se* is serious as regards total prognosis, there is no general agreement as to correct treatment. When the patient is clinically well, most physicians adopt conservative attitudes, forgetting about the parenchymal changes which take place with each passing attack of superimposed inflammatory œdema. Insufficient attention has been paid to Norman Wilson's[5] excellent description of the changes resulting from the " atomiser " effect and " backfiring " through the stenotic orifice affecting the contralateral lung as well as gradually destroying the affected one. As disease progresses and the lung is more completely involved, the tussive effect is lost and the stagnation of secretions, due to the tenacious quality of sputum, loss of ciliary motion and obstruction, leads to further suppuration.

Tuttle, O'Brien, Day and Phillips[6] did a follow-up study of 92 cases of stenosis of major bronchi, 69 cases of ulcero-stenosis and 23 cases of fibro-stenosis. Of the 69, one third died, one third were arrested and one third still unstable with half of them in a hopless condition. The cases with healed fibro-stenosis were just as badly off. Chamberlain and Gordon[7] specifically classified their fibro-stenotic lesions into mild, moderate and marked, and considered the problem essentially one of obstruction. In their opinion the physiologic morbidity was directly proportional to the location, degree, and duration of the stenosis.

While local treatment may be of great importance before the stenotic process becomes severe, it becomes urgent to salvage what is possible before secondary infection and progressive disease have supervened. The tendency to temporise since the advent of antibiotics and the use of aerosols is best illustrated in an article by the French authors Kourilsky, Fourestier, Brille and Piton.[8] They reported three patients treated with sulphonamide and penicillin and controlled on this regimen. The suggestion was made by them that many cases of tuberculous stenosis were overlooked but compatible with long life, and, since surgical treatment was severe, the use of drugs might carry patients along without surgery.

A follow-up study of patients with varying degrees of stenotic lesions discharged from this hospital was made. While the results are not conclusive, they point in general to the need for a more radical approach. Of 22 patients with ulcero- or fibro-stenosis, 10 are now dead, 4 have had pneumonectomy while 1 is awaiting operation, 5 are carrying on with varying degrees of symptoms, and only 2 may be considered clinically well. The average period of follow-up is 10 years, with as long as 16 years and as short as 2 years.

The following cases are presented as examples of the varying clinical patterns in the problem of tuberculo-stenosis.

CASE 1.—M.F., a white female, age 48, had the onset of symptoms in 1945 when she developed a dry cough, lassitude and dyspnœa. She had been treated for asthma for some time but no X-ray had been taken. The cough became productive in November 1946 and tuberculosis was diagnosed. Bronchoscopy at that time revealed stenosis of the left main stem bronchus. She was admitted to a sanatorium, where sputa examinations were supposedly negative for acid-fast bacilli. She gained weight and was discharged to continue at rest at home. In April 1948 she again developed fever, productive cough, hoarseness, dyspnœa, fatigue, and pain in the left chest. It was with these symptoms that she entered the National Jewish Hospital on May 22, 1948.

She was then acutely ill and toxic. The left chest revealed dullness to percussion, increased vocal fremitus, diminished breath sounds and numerous inspiratory râles. The heart was normal except for a tachycardia of 104/minute. Clubbing of the fingers was present. The remainder of the examination was not remarkable. On the neck was a healed post-thyroidectomy scar.

Laboratory findings: The sputum was highly positive for acid-fast bacilli. R.B.C., 3,200,000; Hgb., 8 grams; W.B.C., 15,000 with 82 per cent. polys, 16 per cent. lymphocytes and 2 per cent. monocytes. E.S.R., 140 millimetres. Urine, trace of albumin. E.K.G., no abnormal findings. X-ray, extensive radiopacity over entire left hemithorax with areas of increased translucency. Heart and trachea were markedly displaced to the left.

Course in hospital: The patient was quite toxic with temperatures ranging up to 104° F. Cough was severe and productive of about 4 oz. of sputum daily. On June 2, 1948, bronchoscopy revealed marked narrowing of the left stem bronchus and a thickened velvety red mucosa. This was partially dilated, and following this the expectoration was increased. The patient was placed on streptomycin, and developed an exfoliative dermatitis. The dermatitis gradually subsided following the discontinuation of the streptomycin. Epinephrin aerosol was started, but no relief of the dyspnœa occurred. The patient grew more dyspnœic, toxic and weaker, and continued to lose weight. The sputum became copious and very foul. A pleural effusion developed on the right and severe coughing bouts produced cyanosis. Patient expired suddenly on October 7, 1948, following a massive hæmoptysis.

Post-mortem examination revealed the following:

1. Stenosis of left main bronchus at bifurcation of upper and lower lobe bronchus (Fig. 1).
   (*a*) Squamous metaplasia of epithelium.
   (*b*) Inflammatory granulation tissue of submucosa.
2. Tuberculosis of trachea and both main bronchi.
3. Fibrosis and atelectasis of entire left lung.
4. Multiple interlocking cavities replacing left upper lobe and smaller cavities in apical portion of lower lobe.
5. Caseous bronchopneumonia of all lobes of right lung.
6. Tuberculous productive lymphadenitis of hilar lymph nodes.
7. Hæmorrhages into cavities (bleeding vessels not definitely determined).
8. Tuberculous empyema, left lower lung.

CASE 2.—C.K., a white male, age 42, had had recurrent attacks of influenza since 1918. In 1926, cough and expectoration became more severe and he developed night sweats and constant fever. Tuberculosis was diagnosed, and he went to a sanatorium where he remained for three and a half years. There were several small hæmoptyses, and pneumothorax was induced in 1927 on the

left but was discontinued after five months because of excessive fluid. He entered the National Jewish Hospital on November 2, 1930. Examination showed a cavernous lesion involving the left upper lobe and infiltration at the base. Sputum was positive. Left-sided phrenicectomy was performed on February 28, 1931, with improvement of pulmonary symptoms and weight gain. Sputum became negative in November 1931, except for guinea-pig inoculation, and he was discharged on September 15, 1932, as inactive.

After discharge he went home and lived a normal life, working about four to six hours daily. In the winter of 1934-35 cough and expectoration increased and there was slight temperature elevation. A nine-rib thoracoplasty was done with conversion of the sputum after the third stage. He entered the National Jewish Hospital again on July 27, 1936. He continued to raise one ounce of sputum daily, which was negative throughout 1936. Bronchoscopy in December 1939 showed ulceration of the carina with narrowing and stenosis of the left main bronchus. The ulcer was treated with 30 per cent. silver nitrate, with subsequent healing by April 1940. He was discharged from hospital on July 25, 1941, as apparently arrested with full working capacity. He continued to be seen periodically in the Out-Patient Department. For the next several years he continued to raise from 1 oz. to 4 oz. of thick yellow sputum with frequent episodes of retention, with elevation of temperature lasting for two to three days. These were treated with postural drainage, sulphadiazine and steam inhalation. On June 30, 1947, he was readmitted for a pneumonectomy. Following a preliminary two-week course of streptomycin, pneumonectomy was attempted on October 20, 1947, but patient went into shock during the stripping of the pleura and, after insertion of lucite spheres to maintain the space, the operation was discontinued. The post-operative course was uneventful, and he was discharged on November 25, 1947.

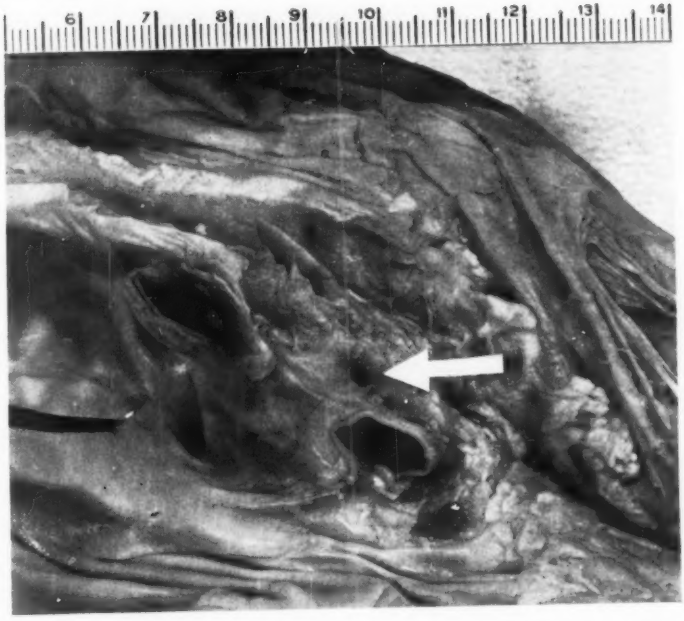
On October 20, 1948, he was admitted again and a pneumonectomy was done on October 27, 1948. Post-operative recovery was uneventful and he was discharged on December 1, 1948. The surgically removed left lung showed the following (Fig. 2):

1. Multiple old caseous calcific foci with definite capsule formation, with perifocal fibrosis and atelectasis.
2. Bronchiectasis of lower lobe with extensive fibrosis and atelectasis.
3. Chronic hyperplastic endobronchial changes with obliteration of lumen of upper lobe bronchus.
4. Thickening of wall of left main bronchus with considerable narrowing of lumen.
5. Endarteritis obliterans, upper and lower lobes.
6. Considerable thickening of pleura and fascia with focal acute and chronic inflammatory changes, with fibrinous exudate.

Case 3.—D.W., a 36-year-old white female, was admitted to the National Jewish Hospital on July 8, 1946. A diagnosis of bilateral moderately advanced pulmonary tuberculosis was made in March 1945. She was treated at a sanatorium for tuberculosis from May 1945 to March 1946. Right pneumothorax, instituted in August 1945, was discontinued in December 1945 because of numerous adhesions. She remained on bed rest until discharged to home in March 1946. She continued to run low-grade evening fever with productive cough and pain in the right chest associated with wheezing, all still present at time of admission.

Physical examination at this time revealed some fine moist râles on the right

PLATE XV



CASE I., M. F.—The arrow indicates the narrowed, puckered mouth of the left stem bronchus contrasted with the relatively normal pulmonary artery and vein.

CASE II., C. K.—The specimen is the markedly shrunken and fibrotic left lung. The bronchial lumen is seen to be markedly narrowed with considerable peribronchial fibrosis.

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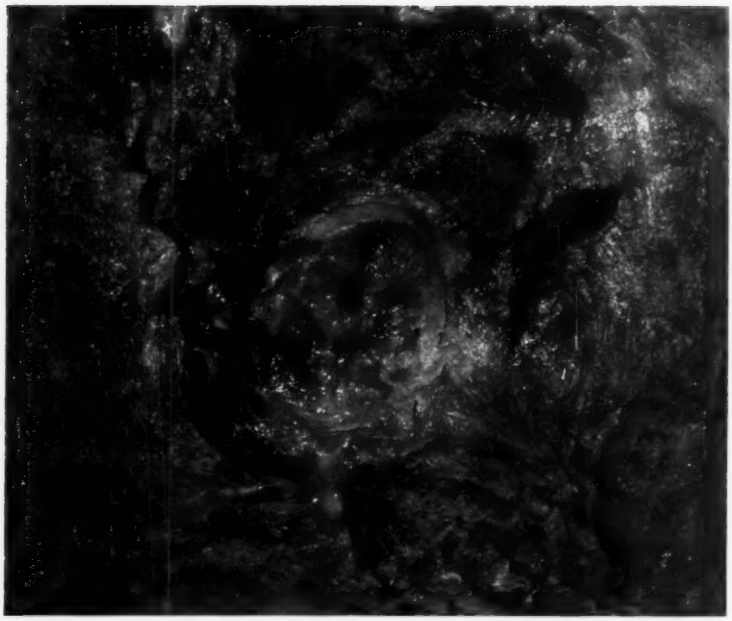
PLATE XVI



CASE III., C. K.—A greatly enlarged view of the right stem bronchus, which is almost completely occluded save for two small openings.

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side, anteriorly, and rhonchi at both apices posteriorly. Chest X-ray showed disseminated disease in the upper lobes, more on the right.

Laboratory findings: The sputum was highly positive. R.B.C., 4,820,000; Hgb., 12·8 grams; W.B.C., 12,600 with 52 per cent. polys, 37 per cent. lymphocytes, 10 per cent. monocytes and 1 per cent. eosinophiles. E.S.R., 48, uncorrected Westergren. Urine was normal except for a trace of albumin.

Pneumothorax was again attempted on the right in October 1946 and on the left in November 1946, but both were unsuccessful. Bronchoscopy in November 1946 revealed extensive ulcero-caseous lesions beginning just below the vocal cords and extending into the right main bronchus. She was placed on streptomycin on December 10, 1946, IM and hourly inhalations during the day of 2·5 grams total. Streptomycin injections were discontinued on February 1, 1947, and inhalation discontinued on March 1, 1947, because of signs of toxicity. X-ray at this time showed essentially no change. Streptomycin nebulisation, ½ gram per day, restarted on April 21, 1947, and 1·5 grams IM per day on May 5, 1947. Sputum continued to remain positive. Streptomycin inhalations were discontinued on June 27, 1947, and streptomycin injections were discontinued on June 28, 1947.

On July 18, 1947, extrapleural lucite plombage with insertion of thirty balls done. Excellent collapse was obtained, but sputum remained consistently positive. In view of the narrowed stem bronchus, pneumonectomy was recommended. On March 17, 1948, she was started on streptomycin again, preparatory to surgery.

Right total pneumonectomy was done on March 24, 1948, with filling of the space with lucite balls, the extrapleural shelf being left intact. Sputum became negative, the patient's activity was gradually increased, and she was discharged from the hospital on December 1, 1948.

Examination of the surgical specimen showed that the entire right lung was removed at operation. The bronchus was resected just above the origin of the upper lobe bronchus. The lung parenchyma was greatly shrunken and distorted. The following findings were present:

1. Stenosis of orifice of upper lobe bronchus with dilatation in distal portion (Fig. 3).
2. Marked shrinking (fibrosis and atelectasis) of upper lobe.
3. Bronchiectasis in middle lobe.
4. Fibrosis of middle lobe.
5. Numerous caseous foci with definite fibrous capsules scattered throughout all the lobes.
6. Occasional caseous nodules with invasion of capsules.
7. Atheromatosis of pulmonary vessels, especially of smaller branches.

Discussion

A radical change in the surgical approach to the treatment of pulmonary tuberculosis has occurred in the past five years. Pulmonary resection has come to be accepted as a major tool, particularly in cases of tuberculous bronchostenosis. The medical literature of the past few years has urged an early surgical approach. Alexander, Sommer and Ehler[9] stated that thoracoplasty should be done early before the stenosis became so tight as to cause retention symptoms. They reserved resection for the patient with symptoms secondary

to such retention. Overhold and Wilson,[10] reviewing their results of pulmonary resection for tuberculosis complicated by tuberculous bronchitis, stated that thoracoplasty had given the best results thus far studied, but that this operation was done on only a fraction of cases. They felt that many patients were unsuitable for surgery because the disease progressed rapidly. Only those becoming stabilised could be accepted. Chamberlain and Gordon[7] preferred thoracoplasty to all other forms of treatment.

It would seem that patients with tuberculous broncho-stenosis present different problems at different times. Before the " opaque lung " appears with all of the secondary suppurative effects commonly associated with it, the stenotic process is already beginning its insidious rôle in such a change. The tussive squeeze and " bechic blast "[11] of each bout of coughing hitting against the stenotic process forms fine sputum droplets, the " atomiser " effect. These fine droplets are readily aspirated into the contralateral lung, producing the " miliary-like " seeding so commonly seen. Much of the sputum which hits the stenotic process bounces back in a " backfiring " effect, causing widespread infection in the homolateral side. Patchy caseous pneumonia, which results particularly in the subpleural zones, may be the explanation for the high incidence of empyema and bronchopleural fistula following the use of pneumothorax in endobronchial tuberculosis.

Hilding's[12] explanation of the rôle of the cilia in contributing to atelectasis, as well as the part played by the slowing of the air stream attendant upon the narrowing of the bronchial lumen, and the development of secondary infection resulting from inadequate drainage, pile additional difficulty upon the spreading tuberculous infection. Some of these ill effects can be obviated by early treatment. Thoracoplasty must be done while the process can still be halted to save as much of the affected lung as possible. With permanent collapse of the chest wall, the " atomiser " and " backfiring " evils are reduced. If after a reasonable period the thoracoplasty alone is not completely effective, resection may still be undertaken.

If all the changes described above are allowed to progress, the pattern of the " opaque " lung appears. This may be considered the end stage in the process, although symptoms will vary with the degree of stenosis, the severity of the suppuration behind it, and the opportunity for drainage. Recognising the problems involved in the periodic inflammatory swelling of the already narrowed bronchial lumen as well as the practically non-existent respiratory function on that side, the decision regarding pulmonary resection should not be delayed for too long. Admittedly, some individuals may carry on for long periods of time without serious incapacitation. In a lengthy follow-up study in our own series as well as those reported, long-term results of conservative handling were generally poor. In the cases presented, this is well brought out by Case 1 (M.F.), who apparently carried on satisfactorily until a serious anaerobic infection supervened. In Case 2 (C.K.), the patient was able to work for a few hours each day, but retention symptoms were frequent and resection was eventually necessary. While one might conceivably await severe symptoms before deciding on resection, it would seem best to regard this operation as inevitable in the majority of cases and proceed at once, while the patient is in good general health.

Summary

1. The mechanics of tuberculous ulcero- and fibro-stenosis are discussed.

2. The poor prognosis for cases of this type is presented.

3. Cases are described to illustrate the various features of the condition.

4. Thoracoplasty is recommended before the " opaque lung " appears to forestall further parenchymal damage by the " atomiser " and " back-firing " effects.

5. Resection is to be considered early after the appearance of the " opaque lung " as not only necessary but inevitable.

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SOME CONSIDERATIONS IN THE POST-OPERATIVE COURSE OF PATIENTS SUBMITTED TO THORACOPLASTY*

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The material on which this study is based consists of 85 thoracoplasties completed during 1948 in Yardley Green Hospital. Eighty of them were done for tuberculous cavitation and 5 for empyema; 209 stages were done in all, 192 on those with cavitation—an average of 2·4 per case—and 17 for empyema, an average of 3·4 per case.

* Based on a paper read before the annual meeting of the British Tuberculosis Association at Cambridge, April 1949.

The average age at operation was 29 years; the youngest was 15 years and the oldest 49 years; 46 of the patients were male and 39 were female.

Excluding the empyemata, the cases have been divided, on the basis of their radiological appearance, into three types:

(*a*) Chronic fibro-caseous disease with cavitation.
(*b*) Chronic fibroid disease with cavitation.
(*c*) Chronic tension cavity.

The empyemata consisted of two groups:

(*a*) Pure tuberculous empyema.
(*b*) Empyema with broncho-pleural fistula and mixed infection.

The differentiation of patients into these groups depends, of course, to some extent on personal interpretation of X-ray appearances, though I think everyone would agree with the description of those cases characteristic of a group. A number of them could have been put in a different class, but they have been rather grouped according to their most outstanding features.

In this study an attempt has been made to correlate the incidence of post-operative complications with the type of disease for which the operation is done. The details of the various groups are given in Tables I to IV.

Figures 1 and 2 show the type of case described as " Chronic fibro-caseous disease with cavitation " before and after thoracoplasty.

TABLE I.—CHRONIC FIBRO-CASEOUS DISEASE WITH CAVITATION

(GROUP A)

Number of Cases in Group, 40

Males	(Average age at operation 29$\frac{4}{12}$)	20
Females	(„ „ „ „ 26$\frac{1}{2}$)	20
	Total	40

General Condition before Operation

Good	19
Fair	17
Doubtful	4

Condition of Contra-lateral Lung

Clear	7
Slight disease	7
Moderate-heavy disease	26

(5 had A.P. and one cavitation in contra-lateral lung at time of operation.)

Average duration of disease, 42$\frac{1}{2}$ months.

The average duration of disease in this group is longer than in the others, as indeed is to be expected. The disparity between the sexes must also be mentioned, as it may be significant.

Figures 3 and 4 show radiographs of a patient placed in the group of " Chronic fibroid disease with cavitation " before and after thoracoplasty.

TABLE II.—CHRONIC FIBROID DISEASE WITH CAVITATION

(GROUP B)

Number of Cases in Group, 15

Males	(Average age 35 years)	14
Females	(„ „ 34 „)	1
	Total	15

General Condition before Operation

Good	11
Fair	4
Doubtful	Nil

Condition of Contra-lateral Lung

Clear	4
Slight disease	2
Moderate-heavy disease	9

(One had cavitation on contra-lateral side.)

Average duration of disease before operation, 57 months.

Figures 5 and 6 show radiographs of a patient in the group "Chronic tension cavity" before and after thoracoplasty.

TABLE III.—CHRONIC TENSION CAVITY

(GROUP C)

Number of Cases in Group, 25

Males	(Average age $32\frac{5}{12}$ years)	10
Females	(„ „ $27\frac{3}{12}$ „)	15
	Total	25

General Condition before Operation

Good	16
Fair	8
Doubtful	1

Condition of Contra-lateral Lung

Clear	7
Slight disease	6
Moderate-heavy disease	12

(1 A.P. controlling cavitation.)

Average duration of disease before operation, 38 months.

Two points are worthy of note from a survey of the material:

(1) The low proportion of patients in poor general condition. This is due not to lack of severity of the disease, but to careful pre-operative treatment.

(2) The high proportion of patients with fairly marked disease in the contralateral lung.

TABLE IV.—EMPYEMATA

(Group E)

Number of Cases in Group, 5

Males	(Average age 31½ years)	2
Females	(„ „ 30 „)	3
	Total	5

General Condition before Operation

Good	Nil
Fair	2 (Pure tuberculous empyema.)
Doubtful	3 (Mixed infection empyemata with bronchopleural fistula.)

Condition of Contra-lateral Lung

Slight disease	2
Moderate-heavy disease	3

Average duration of disease before operation, 38 months.

TECHNIQUE OF OPERATION

Most of the thoracoplasties were done under local anæsthesia by brachial plexus block, intercostal nerve block, and local infiltration of skin and muscles. A large circumscapular incision was used. 2½-3½ ribs were removed at Stage 1, 2½-4 ribs at Stage 2, and a similar number at Stage 3 if it was indicated. Extrafascial apicolysis was also done in the vast majority of cases, and always in cases of empyema. Only those cases with a laterally placed cavity and slight disease elsewhere were left without apicolysis. Remobilisation of the apex at Stage 2 was frequently done, and in a number of cases a periosteo-muscular flap was used to keep the apex down. The intercostal muscles were not removed at any stage.

Routine post-operative treatment consisted of rectal drip, half-hourly pulse and blood-pressure recordings, oxygen by B.L.B. mask and encouragement to cough at regular intervals. The patients are kept lying flat, being turned from side to side for 8 hours post-operatively, and are then raised gradually to a sitting position.

RESULTS OF INVESTIGATION

The post-operative course of thoracoplasty needs considering in two separate ways: the immediate post-operative complications and treatment, which will be dealt with according to the number of the stages done; and post-operative considerations which affect the patient as an individual after thoracoplasty. These will be considered on the basis of the number of patients operated upon.

SHOCK

I am not sure that sufficient attention is paid to the possibility of severe shock after any stage of a thoracoplasty. It depends, of course, on the condition of the patient before operation and on the type and duration of operation

TABLE V.—COMPLICATIONS OCCURRING IN 209 STAGES OF THORACOPLASTY

	Group A		*Group B*		*Group C*		*Group E*		*Total*	
	Males	*Females*	*Males*	*Females*	*Males*	*Females*	*Males*	*Females*	*Males*	*Females*
Shock ..	Nil	2	1	Nil	2	2	2	5	5	9
Dyspnœa ..	3	16	7	Nil	4	9	Nil	1 (Spread of disease)	14	26
Vomiting ..	Nil	5	Nil	Nil	2	10	Nil	3	2	18
Atelectasis ..	2	5	4	Nil	1	3	Nil	Nil	7	8
Fluid in pleura	3	4	2	Nil	4	3	—	—	9	7
Average fall in Hb% ..	17%	15%	15·7%	17%	15·7%	8·7%	10%	14·8%		

performed. There were a few cases, however, in which severe shock developed unexpectedly, and might have been fatal if it had not been recognised and dealt with in an early stage. Shock occurred 14 times in 209 stages: twice in Group A, once in Group B, 4 times in Group C, and 7 times in Group E. It occurred 10 times in women and 4 times in men.

Its treatment is simple if it is recognised at an early stage, and I think the only way to do this is to take the pulse rate and blood pressure at frequent and regular intervals.

Shock obviously occurs more frequently in cases undergoing thoracoplasty for empyema or in revision thoracoplasties, but there was no evident relationship between the type of disease, the duration of the disease, or the sex of the patient, and the development of this complication.

DYSPNŒA

Dyspnœa may be due to reduction in the amount of functioning lung available, to paradoxical respiration, or to mediastinal flutter. The first is, of course, the most common and frequent cause of dyspnœa, although in the majority of cases the reduction in the amount of functioning lung is a temporary phenomenon, and, with the development of compensatory mechanisms, passes off. In many cases dyspnœa is due to a combination of factors, not the least of which might be a reduction in the available amount of hæmoglobin in the blood, which should therefore be kept at an adequate level.

Dyspnœa in this series occurred 40 times in the 209 operations. It occurred 19 times in Group A, 7 times in Group B, 13 times in Group C, and once in Group E—when it was due to spread of disease in the contra-lateral lung. In most of these cases dyspnœa was due to a combination of factors, but in 17 cases one factor was thought to be the outstanding one.

On 5 occasions, chronic bronchitis and emphysema.
„ 4 „ contra-lateral A.P.
„ 3 „ spread of disease in other lung.
„ 2 „ atelectasis of the lung.
„ 2 „ contra-lateral pleural thickening (empyema).
„ 1 „ pulmonary œdema.

The treatment of this distressing complication depends upon the factors responsible. Oxygen is generally needed and should be given then efficiently. Blood may be given with advantage in the form of packed cells. Paradoxical respiration should be controlled, if possible by splinting. Bronchoscopic suction may relieve atelectasis if this cannot be done by posture and coughing, and air or fluid should be removed from the pleural space if indicated.

Dyspnœa appears to occur most often in Group A cases, who usually have a more widespread type of disease. It is uncommon in cases of empyemata, presumably due to the thickened mediastinum and the fact that operation is not interfering with any functioning lung.

It appears to be more common in women than in men. It occurred 27 times in female and 13 times in male cases.

Vomiting

So frequent is transient vomiting after thoracoplasty that it scarcely ranks as a true complication unless continuing for more than 24 hours. It often helps to get rid of sputum. Persistent vomiting does not appear to depend upon the type of anæsthetic given, but it does seem to be an individual idiosyncrasy. In only 2 patients was vomiting confined to one stage alone. Vomiting occurred 20 times in 209 operations: 18 times in 8 women, and twice in 1 man. It occurred 5 times in Group A—2 patients; nil in Group B; 12 times in Group C—6 patients; 3 times in Group E—1 patient. It must not be forgotten that after thoracoplasty, as after other major operations, an acute dilatation of the stomach may occur and be an extremely serious complication. If vomiting is not due to this cause it is treated by withholding food and fluids by mouth and giving fluid intravenously or rectally. On occasion I have found the empiric method of a few drops of tinct. iodine in milk to have good effect. Vomiting does seem to occur more frequently in females than in males, and, as I have already said, to have a personal incidence. No other relationship could be found.

Hiccough

Hiccough did not occur in this series. It is a rare complication. D'Abreu states that he has seen 4 in his large experience (though not in his own cases), and that they all died (personal communication). Alexander (1938), however, found this complication once only, and then it was only slight.

Atelectasis of Lobe or Lung

This usually occurs on the same side as the thoracoplasty, affecting the lower lobe. All "black" radiographs are not necessarily due to atelectasis. The presence or absence of audible air entry over the lobe is often more help than a radiographic opacity in diagnosis.

Atelectasis occurred 15 times in 13 patients: 7 times in Group A, 4 times in Group B, and 4 times in Group C. It affected the lower lobe of the lung on the side of the operation every time. Bronchoscopy was necessary on five occasions. In no case did the disease spread in the atelectatic lobe, probably because of the very temporary nature of the collapse.

Paralysis of the diaphragm did not increase the incidence of atelectasis

PLATE XVII

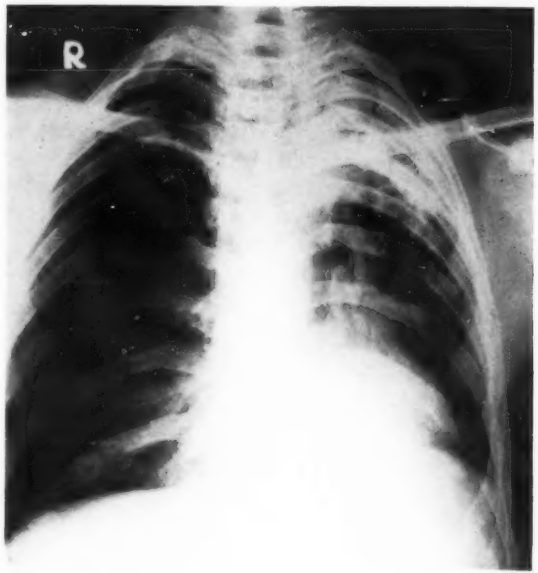

FIG. 1.—X-ray before operation to show type of case described as "Chronic fibro-caseous disease with cavitation." This also shows artificial pneumothorax controlling moderate/heavy disease of the left lung.

FIG. 2.—X-ray nine months after completion of thoracoplasty. Cavities are closed and left A.P. re-expanded. Sputum negative for tubercle bacilli on culture.

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PLATE XVIII

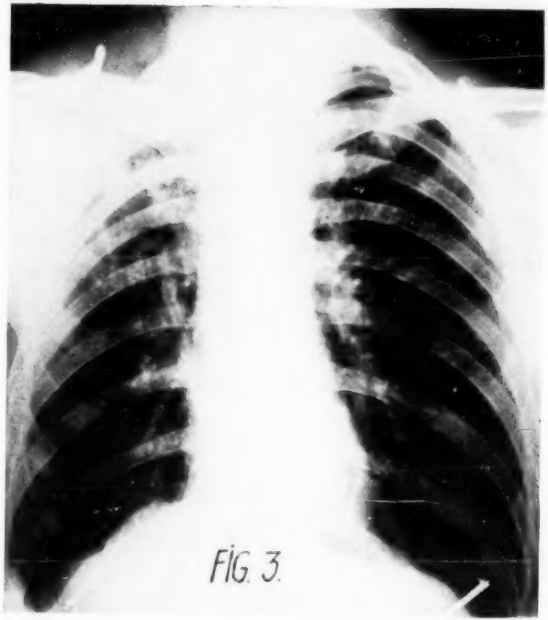

FIG. 3.—X-ray to show a case classified as "Chronic fibroid disease with cavitation" before operation.

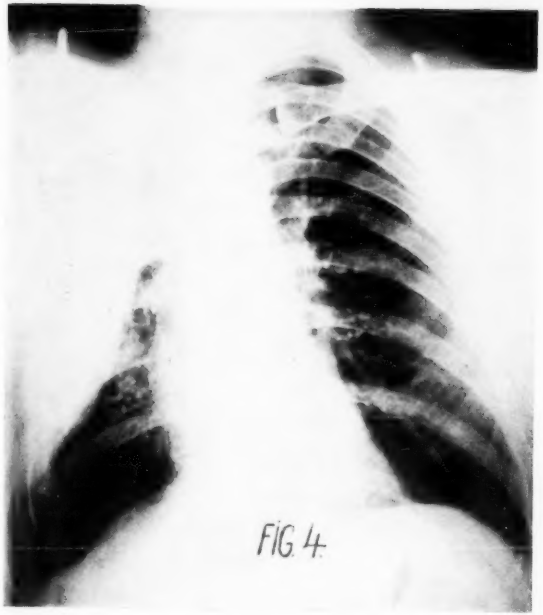

FIG. 4.—X-ray nine months after completion of thoracoplasty. Cavities are closed and sputum is negative for T.B. on culture.

following thoracoplasty on the paralysed side. Nine patients had 20 stages done on the side where the diaphragm was paralysed: 2 cases of atelectasis occurred out of this number. Of the 172 stages done on patients whose diaphragms were mobile before the operation, 13 developed atelectasis. Thus approximately an equal proportion of patients with and without paralysed diaphragms developed atelectasis.

In the prevention of atelectasis after operation encouragement to cough is most important. If it occurs, postural drainage and coughing will clear most cases rapidly. Bronchoscopy may be required in those patients who are unwilling or unable to clear their bronchi.

Spread of Disease to Contra-lateral Lung

This is the most dreaded complication of thoracoplasty. Mostly it is due to bronchogenic dissemination of infected sputum. If sputum can be kept out of the opposite lung during the operation and the post-operative phase, rarely will spread or reactivation of disease occur in the contra-lateral lung.

Local anæsthesia is important in preventing spread, though if pre-operative sedation is too heavy the advantages are lost. It is important that the patient should be asked to cough after the ribs are removed and before apicolysis is begun, the lung being supported by the surgeon's hand, and again at the close of the operation before suturing is begun. It may be advisable to bronchoscope a patient before and after operation if a large amount of sputum is present.

Three patients suffered from "spread" of disease and did not receive streptomycin for its treatment.

The first patient was a woman of 37 with cavitation in the right lung (Group A) and bronchogenic infiltration in the upper lobe of the left lung, regressive before operation. She had a heavy bronchogenic spread to the whole of the left lung after the first stage of her thoracoplasty. Her general reaction was not very marked, but the disease proved progressive. It was impossible to complete her thoracoplasty satisfactorily, and she now has bilateral cavitation and has a very poor prognosis.

The second patient was a woman aged 24 years, a Group C patient, who had a chronic tension cavity in the left lung, and whose right lung was clear before operation. She had heavy bronchogenic spread to the whole of the right lung after the first stage of her thoracoplasty. Her general reaction was marked, and it was necessary to delay her second stage for 3 months. Her thoracoplasty was then completed, however, and she has since been discharged, sputum negative, and progressing favourably. The disease in the contra-lateral lung has steadily regressed.

The third patient was a woman of 22 who had a mixed infection empyema, with a large broncho-pleural fistula on the left side and a very extensive lesion on the right side, thought to be healed. A heavy bronchogenic spread of disease to the whole of the right lung followed the anterior (fourth) stage of her thoracoplasty. Reaction at the time was marked, and she was extremely ill, dyspnœic, and cyanotic. Though not expected to survive, she rather surprisingly did so, improved rapidly, and now appears to have regressive disease in the right lung.

Thus, of 3 patients who suffered from "spread" of disease during thora-

coplasty, two showed regression of the disease, and in only 1 did a progressive lesion develop.

Two patients suffered from spread of disease while receiving streptomycin as an " umbrella." The drug was continued for an extended course of 12 weeks, after the spread occurred, in a dosage of 0·25 gm. every 6 hours. The first of these patients was a woman aged 29 years, who came into Group A with chronic fibro-caseous disease and cavitation in the right lung, and who had, before operation, a minimal quiescent lesion in the left lung. She suffered a heavy bronchogenic spread to the whole of the left lung after the first stage of her thoracoplasty. She had a marked general reaction, but her condition was not dangerous.

Stages 2 and 3 of the thoracoplasty were done 15 and 18 weeks after the first stage. The cavity appears to be closed, but the sputum is still occasionally positive, and is probably coming from the left lung. The condition is proving to be very slowly regressive, though this patient has had three extended courses of streptomycin.

The second patient, who had a spread of disease while receiving streptomycin as an " umbrella," was a woman of 26 with chronic fibro-caseous disease and cavitation in the left lung and quiescent disease of the right lung (Group A). She had a heavy bronchogenic spread to the whole of the right lung after the first stage of her thoracoplasty. Her general reaction was marked, but of short duration, and stages 2 and 3 of the thoracoplasty were not delayed. The cavity was closed by the operation, and the patient has been discharged, sputum negative, and apparently progressing favourably. This patient has not at any time had physical signs over her recently infected lung.

Spread of disease occurred more commonly in female patients suffering from fibro-caseous disease with cavitation (Group A). The average duration of disease in cases who had such spreading disease was 57 months, somewhat longer than the average for this group (42½ months).

There are two points which may be valuable for estimating prognosis in patients with spread of disease during thoracoplasty. The first is that a sharp general reaction is favourable if of short duration; the second, that if physical signs develop over the newly infected lung, the condition will be progressive, or only very slowly regressive.

I consider that streptomycin is of value in these cases, but that it need not be administered until spread has occurred. Not only does the general condition improve under streptomycin, but it may allow the thoracoplasty to be continued and thus improve the chances of cavity closure. General treatment, as for any recent tuberculous lesion, is also of the greatest importance.

Development of Fluid in Pleura

Development of fluid in the pleura is a not infrequent complication of thoracoplasty. It may be due to tearing the pleura during operation, but in many cases develops quite apart from such injury. In this regard it might be mentioned that local anæsthetic is frequently injected into the pleural cavity during anæsthetisation, and this may give rise to some of the so-called idiopathic effusions which develop during the course of thoracoplasty.

The fluid itself has little effect unless it is of sufficient amount to cause

mediastinal displacement. One should exercise care not to mistake the presence of fluid with an atelectasis of the lobe; both give a very similar radiographic appearance. I find the stethoscope a more accurate diagnostic aid on this point.

Fluid developed 16 times in 192 stages; of these 4 had some fluid present pre-operatively; in 5 of the 16 patients who developed fluid the pleura was torn at operation, but in at least an equal number of cases the pleura was torn without any fluid developing.

Group A	7 cases	4 female	3 male	3 required aspiration
Group B	2 „	0 „	2 „	1 „ „
Group C	7 „	3 „	4 „	2 „ „
	16	7	9	6

Thus of 16 cases, 6 required aspiration.

These figures show that aspiration is not always required when fluid develops, and that in most cases one aspiration is sufficient to cause absorption of the fluid. The most important factor in the development of fluid in the pleura appears to be trauma during operation. Other factors involved are difficult to identify.

This is one of the few complications which appear to be more common in men than in women.

Cardiac Complications

A rapid pulse is common after a thoracoplasty, though in most cases it soon returns to normal figures.

This post-operative rapidity may be due to a number of factors—local anæsthetic " poisoning," the adrenalin present in the local anæsthetic, shock, mediastinal flutter, or psychological factors.

Two patients in the series had organic valvular lesions—one a mitral regurgitation and the other a mitral stenosis. Six stages were done on these two patients; all were uneventful. As a precautionary measure thoracoplasty operation performed on patients with organic heart disease should be done in small stages. I found the administration of penicillin to cover the stages a soothing procedure for the surgeon, as should any infection reach the blood stream localisation on the cardiac valves might be prevented.

Pleurisy

A pleural rub may develop on the operated side or in some cases on the contra-lateral side after thoracoplasty. It occurred twice on the contra-lateral side in this series of patients. In neither case did it presage the spread of the disease. Twice also was pleural rub noticed on the operated side during a thoracoplasty, and this case also has progressed favourably. The development of a pleural rub does not appear to be of serious prognostic import.

Hæmorrhage

Hæmorrhage may occur from the wound as an ooze. It may occur into the Semb's space, or it may effect the sub-muscular space or the layers of the wound. Slight oozing from the wound is so common as not to be classified as a

complication. It was sufficiently marked to be noted in one of the 209 stages. Hæmatoma in the wound occurred twice, both after anterior stages of thoracoplasty.

Hæmorrhage into the wound may cause severe pain. This occurred once.

I pay a great deal of attention to hæmostasis during operation. Small vessels are sealed with diathermy, larger ones tied with thread. Blood loss is therefore kept to a minimum, but nevertheless a very serious drop—in the hæmoglobin percentage at any rate—occurs after most thoracoplasties. Reference to Table V will show the average drop to be in the region of 15 per cent.; this point was reached more often 3-5 days after operation, not immediately. Transfusion was therefore used almost as a routine in these cases; the average amount given to the patients in this series was 1 pint per stage. Before operation a full blood count is of course done, and the blood is brought up to normal, or at any rate as near normal as one can get, by the use of transfusions, iron preparations, a high protein diet, and additional vitamins. Seventy per cent. hæmoglobin was taken as the critical level for transfusion, which was given routinely below this figure.

Infection and Breakdown of Wounds

Three patients had gaping of their wounds requiring local resuture. These were not due to infection, but to breaking of the nylon sutures which we use. All healed by first intention after resuture, and we regard these few instances as a small price to pay for the kindly wound-healing which we experience with nylon.

Of a number of patients who were sutured with interrupted thread, 2 are still discharging thread sutures from their wounds 10 months after completion of the thoracoplasty. This is an annoying but not dangerous sequel.

One patient developed a frank infection of the Semb's space. Fortunately it was a non-tuberculous infection, which, however, required drainage. It healed fairly quickly, the thoracoplasty was completed, and the patient is now discharged, sputum negative, and doing well.

Two patients suffered tuberculous infection of their Semb's spaces. Both were mixed infection empyemata with broncho-pleural fistulæ and old tracks from previous pleural drainage. These patients were treated with streptomycin. It is interesting to note that in one no healing reaction to the streptomycin followed. Simultaneous estimations of the streptomycin level in the blood and wound fluid were undertaken. These showed 10 micro-grams per c.c. in the blood and no streptomycin could be discovered in the wound discharge. This patient began to complain of giddiness at the same time, so systemic streptomycin was discontinued and the drug was given locally in $\frac{1}{2}$-gram doses into the wound; the sinus promptly healed. It has since broken down again, but no tubercle bacilli can be isolated from it on this occasion.

The other case healed her tuberculous wound infection, but unfortunately I am forced to aspirate her pleura at regular intervals, and thus re-infect her wound space, and the sinus has re-opened.

Thus 6 of 192 stages which were done for parenchymal disease had some note made about their wounds (3 per cent.). Five were trivial—localised gaping in 3, and discharge of thread stitches in 2. Only 1 had a serious wound infection

(0·5 per cent.). Of 17 stages done for empyema 2 developed serious wound infection (11·7 per cent.).

Nerve Complications

The nerve most commonly affected by thoracoplasty is the sympathetic chain. This was damaged 10 times in 209 stages, and caused a Horner's syndrome. We do not regard this as a serious complication, but as a price to be paid in some instances for a good extra-fascial apicolysis.

A more serious injury is damage to the phrenic nerve, presumably due to traction occurring during a difficult apicolysis. This occurred in 2 of the 209 stages done—1 case recovered movement of the diaphragm in a matter of weeks after the operation; the other is still paralysed. (This was a very difficult revision thoracoplasty with remobilisation of the apex.)

The first thoracic nerve root may also be damaged, very occasionally, at operation; sometimes later, when it is presumably due to traction. It gives rise to pain, tingling, and weakness of the hand. This occurred in 2 of the 209 stages; both recovered within a few weeks.

Pressure on the intercostal nerve may develop after operation. To reduce the risk I make a habit of resecting part of the lowest intercostal nerve in order that pressure by the scapula inside the uppermost unresected rib should cause no pain. Nevertheless, intercostal pain developed in 3 of the 209 stages, and was sufficiently severe to require injection of procain in oil in 2 patients.

Finally the patient may get temporary paralysis or paresis due to pressure on any particular nerve by his posture during operation. In 1 case paresis of the deltoid muscle, presumably caused by pressure on the circumflex humeral nerve, occurred. The patient was treated by placing his arm in an abduction splint for a few weeks, and with suitable physiotherapy recovered fully.

Thus, 16 patients had 20 complications out of the 209 stages done (10 per cent.). These nerve complications are almost invariably due to doing apicolysis in difficult cases; but it is in just such cases that apicolysis is important, and they should not act as a deterrent.

So far, we have been considering the complications and considerations affecting stages of thoracoplasty; we must now consider the patient as a whole after thoracoplasty.

Deaths

Three deaths occurred in this series (3·75 per cent. of the cases done). They did not occur in cases regarded as poor risks before operation.

1. The first was a girl of 22, a Group C case, who was submitted to thoracoplasty 57 months after the diagnosis of her disease. She developed pulmonary œdema 5 days after her second-stage operation with a very high temperature and died 2 days later from this complication. I do not know the cause of her pulmonary œdema nor could it be discovered at post mortem. No œdema was present elsewhere in her body. She was getting streptomycin as an "umbrella," but I had the impression that her condition was due to a pulmonary infection. The other possibility is that she was one of those rare cases who respond to auto-tuberculinisation by œdema.

2. Was a male aged 49 years, a Group B case, whose disease had lasted for 54 months from diagnosis until the time of operation. He developed acute

suppurative bronchitis and died 10 days after his second-stage operation. It was known before operation that this man had chronic bronchitis, and the acute flare-up following the second stage was an unfortunate occurrence. The infection was apparently resistant to penicillin and streptomycin.

3. Was a male aged 41 years, a Group B case, whose disease had persisted 102 months from the time of diagnosis to operation. This patient died suddenly 2 days after completion of his third-stage thoracoplasty. At post-mortem he was found to have a pulmonary embolism arising from a silent thrombosis in his left femoral vein.

Thus in this series death was more common in a group of cases which we should generally think the safest, the chronic fibroid. These patients are, as a rule, older, and must be very carefully assessed before operation. In the second case I now regret not postponing his operation till summer.

Sputum Conversion

It is too early to give final figures for the percentage of sputum conversions in this series. We do not regard any patient as being sputum negative until we have negative cultures. (Three repeated at monthly intervals is our criterion.) If the patient has no sputum, gastric lavage is done and the results examined by smear and culture for tubercle bacilli.

So far, on the above standard, 80 per cent. have negative sputum—64 of 80 patients.

Of the 16 patients who are still not converted by our standard:

5 cases have consistently negative sputum on smear, but have not yet had their repeated negative cultures.

2 were cases who had spread of disease during operation and who now have active disease on the contra-lateral side.

3 patients were found to have endobronchial disease, and may be expected to become negative when this lesion is healed.

3 patients still have patent cavities.

3 patients are dead.

I have not been able to determine the time after thoracoplasty at which conversion of sputum occurs in the various types of case. A number of cases become negative on smear immediately after operation, and remain so until some 12 weeks after completion of the operation, when they again show a couple of positive smears. Most of them become negative in the course of a week or two, and in this second negative phase negative cultures will be obtained.

Respiratory Incapacity

In selecting cases for operation, especially as we have no facilities for bronchospirometry, we trust to clinical estimation of the patient's condition. That clinical assessment is generally reliable is shown by the fact that none of our cases have become respiratory cripples, though none were refused operation on the grounds of respiratory inefficiency alone. The vital capacity was done as a routine before and after operation. The lowest vital capacity pre-operatively was 1,200 c.c.; the lowest vital capacity post-operatively was 800 c.c. I pay little attention to the vital capacity in estimation of the operative prognosis, but rely more upon a simple exercise tolerance test.

PLATE XIX

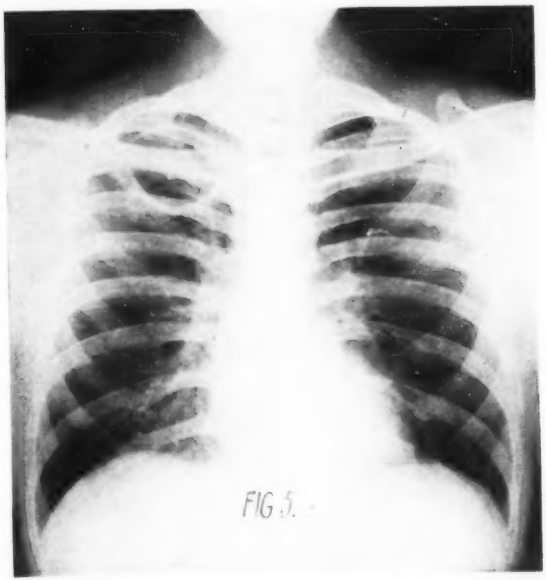

FIG. 5.—X-ray to show another case described as "Chronic tension cavity."

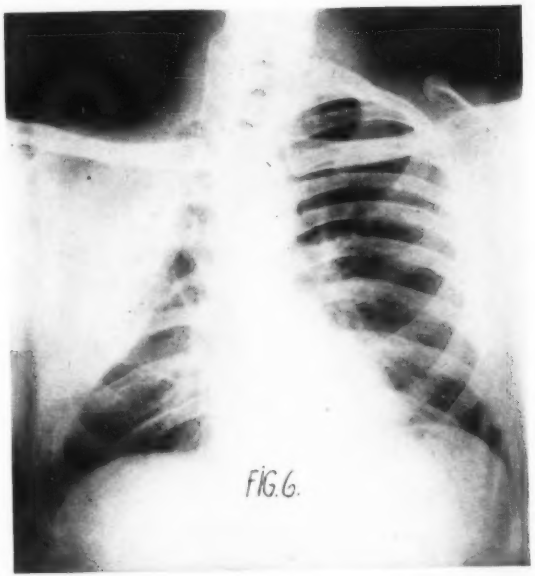

FIG. 6.—X-ray nine months after completion of thoracoplasty. Cavity is closed and sputum is negative for T.B. on culture.

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It is too early yet to say how many patients will return to work. I think this depends quite largely on psychological factors. None of the patients up and about after operation complained of undue restriction of activity from respiratory distress. One doubtful case is where an empyema on the left side led to considerable thickening of the pleura. A right thoracoplasty was done and led to cavity closure and sputum conversion. She does not complain of undue respiratory inefficiency. Breathing exercises after operation for the thoracoplasty side were found to have much value. They must, of course, be given with care and skill, but if this is done the respiratory capacity can often be improved. Thickening of the pleura or adhesion of the two layers of pleura is one of the most serious limiting factors in the respiratory function of a lung.

Urinary Complications

Two patients had episodes of renal failure after operation.

One occurred in a woman of 41 years with a mixed infection empyema, broncho-pleural fistula, and gross enlargement of the liver and spleen, thought to be due to amyloid disease. Gross dependent œdema followed her thoracoplasty but cleared gradually, and she has now recovered.

The other occurred in a man aged 25 years in Group B. He had chronic nephritis before operation, and an acute attack supervened after operation, with marked œdema, and a blood urea of 50 mgm. per cent. His condition has since improved, though leaving his chronic nephritis rather worse than before operation.

A third patient had recurrent attacks of dysuria before, during, and after operation, due to cystitis cystica. Tuberculous infection of his renal tract was excluded before the thoracoplasty.

Miscellaneous Complications

One patient developed signs of an intracranial lesion after operation, considered to be probably a tuberculoma, previously existing. The patient is now ambulant. The possibility of some reversible vascular lesion cannot be excluded.

One patient suffered from dermatitis after each stage. He appeared to be widely sensitive to drugs. His stages were delayed, but the dermatitis cleared eventually on each occasion.

Return to Activity

Every patient was kept in bed for 3 months after completion of the thoracoplasty. They were then allowed up in carefully graduated stages. They were usually discharged on reaching 4 hours up and ½ hour walking. After discharge they were supervised at 2-monthly intervals for 6 months after operation, then 3-monthly intervals for a year, then 6-monthly intervals, and then annually.

We have had no case where recrudescence of activity followed the thoracoplasty. The testing time has still to come, of course, as few, if any, of them have yet returned to full working activity.

Summary

All the patients submitted to thoracoplasty during the year 1948 in Yardley Green Hospital have been classified into four groups. An attempt has been

made to ascertain if any type of disease is more liable to complications during operation.

It was found that mortality was greatest in patients with chronic fibroid disease (Group B) submitted to thoracoplasty; though from causes other than tuberculosis.

Spread of disease during thoracoplasty occurred more commonly in women with chronic fibro-caseous disease (Group A).

Complications occurred more commonly in women than in men undergoing thoracoplasty.

The various complications which occurred in this series have been discussed briefly.

I should like to thank Mr. d'Abreu, Director of the Department of Thoracic Surgery at Yardley Green Hospital, for allowing me to use this material, and Dr. Geddes, Superintendent of the Hospital, and Senior Consultant Chest Physician, for his invaluable advice in dealing with the many problems which arose in these patients.

THE FAMILIAL ASPECTS OF SARCOIDOSIS

By EDWIN R. BICKERSTAFF

From the Queen Elizabeth Hospital, Birmingham

The literature on the closely related syndromes, now thought to be different manifestations of sarcoidosis, shows a remarkable sparsity of recorded examples of the disease in more than one member of the same family. Many excellent and extensive reviews such as those by Hunter (1936), Longcope and Pierson (1937), Pinner (1938), Longcope (1941) and Reisner (1944) cover most of the previous work without reference to its familial occurrence. At the Réunion Dermatologique at Strasbourg in May 1934 a special session was devoted to various aspects of the disease, its clinical manifestations, and in particular the ætiology; but the effect on our views of its ætiology which its appearance in siblings might have was not discussed.

The point had been made, however, some years earlier. The first recorded cases were those of Sellei and Berger (1926), whose family of seven siblings, of ages ranging from 36 to 48, had five members affected with cutaneous lesions which clinically and histologically showed the picture of sarcoid. In 1936 Jacobsen described two sisters, said to have " tuberculous adenitis and dactylitis "; they both had generalised lymph-gland enlargement, and one showed the characteristic " osteitis tuberculosa multiplex cystica " of Jüngling (1919). These cases are interesting because, whereas the histological features were those of sarcoidosis, and the second child had a prolonged illness characterised by glandular enlargement with negative Mantoux tests to both bovine and human tuberculin to a strength of 10 mg., yet both died of tuberculosis—the first of tuberculous peritonitis; the second of tuberculous meningitis, bacilli being recovered from the C.-S.F. There was a strong family history of pulmonary tuberculosis. Dressler (1938) described a brother and sister, both considered

to have sarcoidosis, the diagnosis being based on X-ray appearances of mediastinal adenitis and parenchymatous lung changes running a benign course and accompanied by a negative von Pirquet reaction. No histological confirmation was obtained here or in the further two brothers described by the same author the following year (Dressler, 1939). Mediastinal glandular enlargement, early parenchymatous lung changes, only a weakly positive von Pirquet reaction, and the condition running a benign course with a tendency towards resolution again formed the evidence for diagnosis. MacCormac (1939) demonstrated to the Dermatological Section of the Royal Society of Medicine two sisters, aged 54 and 61, the first of whom had lupus pernio, glandular enlargement, mediastinal glandular enlargement and parenchymatous lung changes, and whose skin lesions histologically were characteristic of sarcoid. The second, who had lupoid patches on the skin, could not be fully investigated, but MacCormac (1948) has since stated that there was no doubt whatsoever in his mind, and in the minds of the other dermatologists present, that the lesions were identical.

The brother and sister described by Bøggild (1944) both showed the characteristic osteitis tuberculosa multiplex cystica of Jüngling, one having enlarged neck glands as well. No biopsy was made, and there were no lung changes.

Robinson and Hahn (1947) investigated two negro families, in the first of which two of three siblings showed clinical sarcoidosis, one being confirmed by biopsy. There were ten siblings in the second family, five of whom were examined: three proved histologically to have sarcoidosis, and one other was almost certainly involved. Three years after the original diagnosis active tuberculosis developed in two of them.

The Present Material

The family consists of five brothers and two sisters. All were brought up on a farm in Ireland. As many of them lived out of this country it was impossible to carry out a personal examination of any but the two cases described below. An uncle had asthma and their mother chronic bronchitis. One brother, who has lived in America most of his life, had some obscure chest disease from which he has completely recovered. No details are available.

Case 1.—J. J. Age 27. Born and brought up on a farm in Ireland, came to England in June 1937, and after taking various work throughout the country settled as a magnesium moulder in Birmingham in 1941. He had no important illnesses until 1939, when he developed a cough and some dyspnœa on exertion. This was accompanied by occasional night sweats and a gradual loss of 1½ stones in weight over the next 5 years. In 1943 he began to suffer attacks of vomiting, usually after going out into the open air at the end of a day's moulding. This complaint was a common one amongst his work-mates, but he was unusually severely affected. From 1942 he began to feel weak and listless. The night sweats became more pronounced and he began to bring up frothy sputum whenever he coughed. There was no hæmoptysis. In March 1944 all his symptoms became rapidly worse and he was sent to see Dr. Oscar Brenner at the Birmingham General Hospital and admitted on 10.3.44.

Examination showed a pale man, weighing 139 lbs., whose skin was moist and sweating profusely. Temperature varying between 97·6° and 101°,

pulse 80-90, respirations normal. There was marked finger-clubbing. No abnormality was discovered in the cardiovascular or central nervous system. There was some wasting of the chest muscles posteriorly, and the right side showed diminished movement. Percussion was unaltered, but areas of broncho-vesicular breathing were recorded in the left axilla and at the right base. There were numerous fine râles throughout the right thorax and rhonchi over the right upper lobe. The spleen was enlarged, and throughout the body there was a generalised glandular enlargement. The urine contained a faint trace of albumin. The blood showed a mild hypochromic anæmia. Nine examinations of sputum were negative for tubercle bacilli. X-ray of the chest (12.3.44) showed hilar enlargement and parenchymatous infiltration (see Fig. 1). X-rays of the hands were normal. Biopsy of an axillary gland was reported by Dr. R. A. M. Case to show characteristic appearances of Boeck's sarcoidosis.

The patient gained weight and was discharged from hospital on 24.4.44 feeling well. He has remained well since, except for slight cough. He is now working as a builder and often lives in a dusty atmosphere.

Examined personally 19.5.48. Age 32. Appears healthy. Slight nodular eruption on forehead which has remained unchanged for years. Finger clubbing present. No abnormal signs in cardiovascular or central nervous system, and the only abnormality discovered in the respiratory system was a slight displacement of the trachea to the right. The spleen was still palpable. There were small, discrete glands in the posterior triangles of the neck, the right axilla and the groins. The urine was normal cytologically, biochemically and bacteriologically. The blood still showed a mild hypochromic anæmia with normal white cell count. The sedimentation rate was 18 (Wintrobe). Wassermann negative. Serum albumin 4·2 g. per cent. Serum globulin, 2·8 gm. per cent. Serum calcium, 11·1 mg. per cent. Serum alkaline phosphatase, 6·0 units per cent. X-ray of hands and feet normal. X-ray of chest (19.5.48) showed fibrotic changes with tracheal displacement to the right (see Fig. 2).

Case 2.—A. J. Age 23. Younger brother of J. J. Born and brought up in Ireland, coming to England in 1946 and working as an aluminium welder for two years. In January 1948 began to suffer from anorexia and cough. The latter was non-productive, but caused some pain on both sides of the chest. In February 1948 he began to lose weight, and in the next six weeks lost about 2 stone. In mid-February he began to feel early morning nausea, and after meals would have attacks of coughing culminating in vomiting his food. There was no abdominal pain, but at the beginning of March he had some precordial pain on breathing.

In view of his loss of weight and cough he was referred to the tuberculosis centre, and from there to Professor P. C. P. Cloake's out-patient department, whence he was admitted to the Queen Elizabeth Hospital on 13.3.48. On admission his condition had improved following a week's rest in bed. He was pale and thin, the skin was moist, and there was a slight nodular eruption on the forehead. Temperature ranged between 97° and 99·2°, pulse rate 70-100 and respirations normal. Weight 121 lbs. No abnormality was detected in the cardiovascular or central nervous systems, or in the abdomen. The spleen was not palpable. There was impairment of percussion to either side of the mid-line of the chest posteriorly, and fine râles were heard below the left scapula. There were many enlarged glands, firm, discrete, mobile, non-tender, in the right axilla, the left groin and both posterior triangles of the neck. The urine was normal. A full blood-count was normal. Sedimentation rate 10 (Win-

PLATE XX

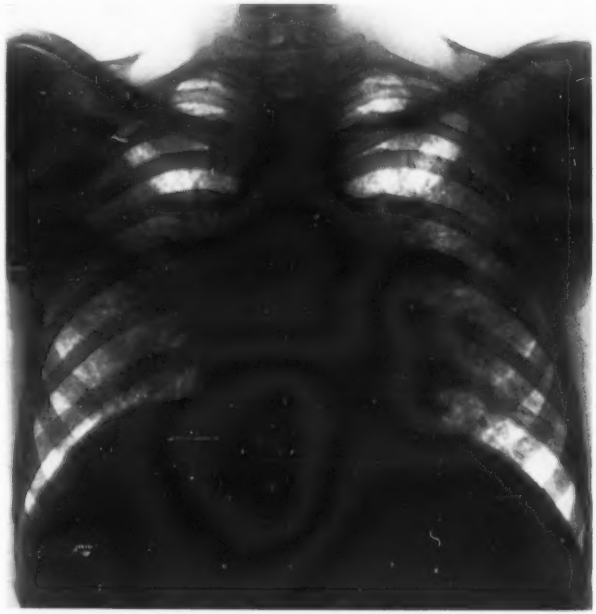

FIG. 1.—J. J. *May*, 1944.

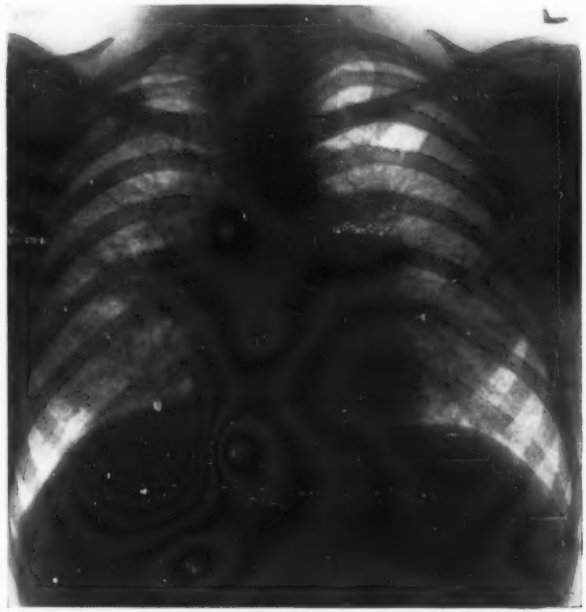

FIG. 2.—J. J. *May*, 1948.

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PLATE XXI

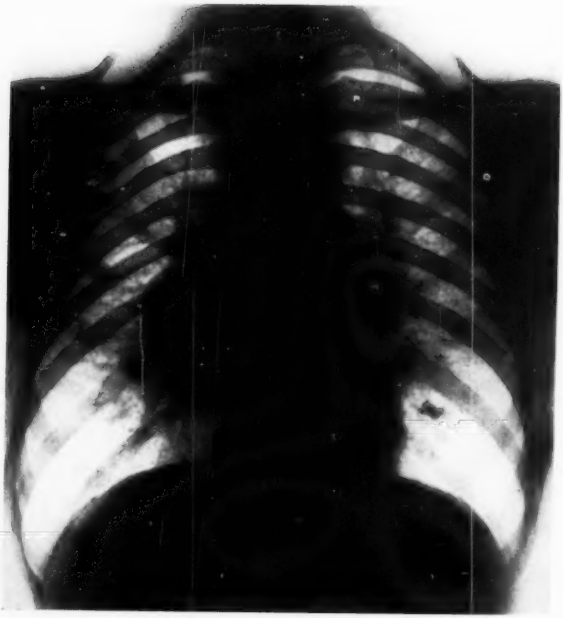

FIG. 3.—A. J. *March*, 1948.

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trobe). Sputum negative for tubercle bacilli. Mantoux negative to 1/100. Serum albumin, 4·0 gm. per cent. Serum globulin, 3·4 gm. per cent. Serum calcium, 11·7 mg. per cent. Serum alkaline phosphatase, 7·5 units per cent. X-ray of hands normal. X-ray of chest showed massive hilar glandular enlargement with reticulation spreading outwards into the parenchyma of the lungs (see Fig. 3). Biopsy of a gland from the neck was reported by Dr. R. L. Bishton to show the changes of sarcoidosis.

The patient improved markedly at rest in hospital, and was discharged on 16.4.48 and went for a holiday in Ireland. During the early part of June he developed further vomiting and soreness of the eyes, and was admitted to the Royal City of Dublin Hospital on 7.6.48. Dr. V. M. Synge (to whom I am indebted for these details) confirmed all previous findings except that he had now developed a bilateral uveitis which had improved by the time of his discharge a month later. Seen in Birmingham towards the end of the year he was quite well.

Discussion

These two brothers have both suffered from a condition affecting the glands, the abdomen and the respiratory system which has been shown histologically in each case to be sarcoidosis. There is not enough evidence available to draw any conclusions regarding the nature of the chest disease which affected the third brother.

Taking these cases in conjunction with those already described in the literature, it is evident that each of the varieties of sarcoidosis, with the exception of Heerfordt's syndrome, has been found to occur in different members of the same family, and in two instances (Sellei and Berger, 1926; Robinson and Hahn, 1947) in several members of the families concerned, making association by coincidence unlikely.

No further definite clues to the ætiology of the condition can be gained from this study. The two brothers had lived for many years on a farm. Longcope and Pierson (1937) had drawn attention to the frequency with which the disease is found in farming communities, and suggestions have in the past been made that sarcoidosis is an abnormal response to the bovine tubercle bacillus.

Many American authors have drawn attention to the prevalence of the condition in the Negro race in America. Lomholt (1934) stated rather dogmatically that the idea that tuberculous infection and sarcoidosis were closely related was being abandoned, and cited Denmark as an example of a country showing a high incidence of sarcoidosis but a low incidence of tuberculosis. This racial prevalence, associated with the now well-established familial occurrence of the disease, forces one to ask whether some genetic force may not be at play—some inherited characteristic, probably recessive in nature, which so alters the " soil " that the response differs from that usually encountered when the " seed " is sown. The finding of " transition forms " (such as those described by Jacobsen, 1936) and the knowledge that a definite proportion of all cases of pulmonary sarcoidosis later develop frank tuberculosis, are evidence in favour of the " seed " being the tubercle bacillus.

It is suggested that were careful search made amongst the siblings of known cases of sarcoidosis, minor sub-clinical involvement might be quite

frequently encountered, in much the same way that unsuspected tuberculosis is so often discovered in the routine examination of the family of a phthisical patient.

Summary

Familial occurrence of sarcoidosis is rarely recorded. The previous literature on this aspect of the disease is reviewed, and two new cases in brothers are described.

It is suggested that some genetic factor affecting the individual's response to the tubercle bacillus may account for the disease.

I acknowledge with gratitude the permission given by Professor P. C. P. Cloake and Dr. Oscar Brenner for me to investigate and record these cases.

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REVIEWS OF BOOKS

Brompton Hospital Reports. Vol. XVII, 1948. Gale and Polden, Aldershot. Pp. 183. Price 10s.

The most significant article in this volume is by R. C. Brock on recurrent and chronic spontaneous pneumothorax. That he should have encountered 71 cases in 11 years shows their frequency. A chronic pneumothorax is defined as one persisting for 3 months or more: the average duration of his 46 cases was 15 months. Many were chronic invalids. For this reason, and also to minimise the danger of acute respiratory infections or contralateral pneumothorax, active treatment is needed. Chronic and recurrent pneumothoraces are commoner in the third and fourth decades. 33 were due to generalised or bullous emphysema, 8 were associated with asthma and bronchitis, 26 were due to solitary bullæ or cystic disease, 6 to an apical scar, 3 to polycystic disease, 4 to visible tear or leak often adjacent to an adhesion, 6 to unknown causes, and 4 to "cuckoo spit." This term is aptly coined to describe multifocal minute areas of alveolar leak seen by a thoracoscope. This mechanism may explain several obscure cases seen at autopsy, and may also be the cause when intact bullæ are seen.

Emphasis is laid on good radiography, including tomography and

bronchography, in the investigation of suspected areas, particularly in order to differentiate large bullæ. Bronchoscopy and intrapleural pressure readings may be valuable, but thoracoscopy gives the most useful information. Large bullæ or cysts need lobectomy or local resection. In others, pleurodesis is indicated: silver nitrate instillation is preferred to iodised oil, hypertonic glucose or poudrage because of its greater reliability. Sometimes it is applied to the lung through a thoracoscope. Alternatively 5-10 minims of a 10 per cent. solution are injected into the pleural cavity from an all-glass syringe. Air and liquid must be aspirated afterwards to secure apposition of the pleural surfaces while still inflamed. Later, induction of an A.P. is attempted, and if incomplete pleurodesis is found, further silver nitrate injected. Of 53 patients treated by pleurodesis, 45 have been successfully followed up, and none has had a relapse. Whilst a more satisfactory pleural irritant may be found, these figures are convincing evidence of the value of this treatment.

A further paper by Brock describes 3 successful cases of pulmonary valvulotomy for the relief of congenital pulmonary stenosis. The results are encouraging, even though 2 cases developed post-operative emboli. He emphasises that this operation so far is only suitable for the valvular type of stenosis, and not the infundibular type, for which Blalock's operation is the procedure of choice.

J. G. Scadding, in an article on the pneumonias associated with epidemic respiratory infections, draws attention to the protean clinical manifestations which constitute so-called primary atypical pneumonia. He makes a plea for the separation of those of known ætiology—*e.g.*, psittacosis, rickettsial pneumonias and infected atelectases presumably complicating upper respiratory catarrh—from pneumonias due to an unidentified virus. Elucidation of the cause in this latter group is rendered extremely difficult by the varying susceptibilities of laboratory animals, and by the frequent contamination with latent respiratory tract viruses in the animals.

W. P. Cleland describes the presence of a lateral thoracic branch of the internal mammary artery in 50 per cent. of the population. It courses over the inner surface of the upper and antero-lateral aspects of the chest wall, and may cause serious hæmorrhage if damaged during refill of an extrapleural pneumonolysis cavity.

A. T. M. Roberts reviews 128 extrapleural pneumothorax operations performed between 1937 and 1942 at the Brompton Hospital. Factors leading to a successful outcome are a short history, a small cavity, not subpleural, and minimal disease in the contralateral lung. Eighty per cent. of 30 such cases are alive and working, but only 45 per cent. of all extrapleural pneumothorax operations, after an average of 8 years, follow-up.

This volume also contains an interesting centenary historical review of the Brompton Hospital, and a summary of advances in thoracic surgery since 1943.

H. G. M.

A Psychiatrist Looks at Tuberculosis. By ERIC WITTKOWER. Published by the N.A.P.T. 1949. Price 12s. 6d.

In this little book Dr. Wittkower analyses the material obtained at lengthy interviews with 785 patients receiving sanatorium or dispensary care for tuberculosis. He discusses first the behaviour of tuberculous patients, secondly the factors determining that behaviour, and thirdly the relevance of emotional factors in the ætiology and course of the disease.

The first section is in some ways the least instructive, for in the absence of a control series it is impossible to say in what way, if at all, the behaviour of these patients is peculiar to the tuberculous. It contains, however, some useful reminders of the varied reactions of patients to their diagnosis and to sanatorium discipline, and of the important help the doctor can give in making the emotional and social adjustments which become necessary.

When one recalls some of the remarkable attributes that have been conferred by other writers on the " phthisic psyche " it is a pleasure to read in the next section the sentence " Has not anybody reason enought to get ' rattled ' on being informed that he is suffering from a serious and perhaps fatal illness, to become bad-tempered if he feels ' rotten ' or is locked up in a sanatorium for an indefinite period, and to kick against the bars which prevent him from leading a normal life ?" This mood of common-sense pervades the book, and it is in this light that the reactions of the patients to their illness are considered.

In the third section the author analyses the premorbid personality and the life-situation at the onset of disease in 300 patients. Although in many the development of a need for escape is quite convincingly demonstrated this does not explain, as Dr. Wittkower points out, the next step to the development of tuberculosis to provide the means of escape. A short analysis of the effect of personality on progress underlines the fact, well known to tuberculosis physicians, that people who are careful of themselves do well, whereas those who work or play too hard do badly, and only gives a psychiatric explanation of why some are cautious and others not.

A final brief section attempts to discover the truth of the saying that patients who worry about their illness do worse than those who adopt a philosophical attitude; but it proves impossible to separate those who worry because their condition gives them good cause, from those whose condition deteriorates because they worry.

This book solves no problems, but it is an interesting record of facts from which the author has been wisely content to draw only the broadest conclusions, and it shows clearly how much room there is for further psychiatric and social study of the tuberculous.

J. V. S.